27839-1314
(K-C 19,691)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of Anderson et al. Art Unit 3761
Serial No. 10/623,030
Filed July 18, 2003
Confirmation No. 4469
For ABSORBENT ARTICLE WITH HIGH QUALITY INK JET IMAGE PRODUCED AT LINE SPEED
Examiner Michele M. Kidwell

June 1, 2010

APPEAL BRIEF

Richard L. Bridge, Reg. No. 40,529
ARMSTRONG TEASDALE LLP
One Metropolitan Square, 26th Floor
St. Louis, Missouri 63102
(314) 621-5070

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APPEAL BRIEF

This is an appeal from the rejection of the claims of the above-referenced application made in the final Office action dated December 30, 2009. A Notice of Appeal was filed on March 30, 2010.

I. REAL PARTY IN INTEREST

The real party in interest in connection with the present appeal is Kimberly-Clark Worldwide, Inc. of 401 N. Lake Street, Neenah, Wisconsin 54957-0349, a corporation of the state of Delaware, owner of a 100 percent interest in the pending application.

II. RELATED APPEALS AND INTERFERENCES

Appellants are not aware of any pending appeals, which may be related to, directly affect or be directly affected by, or have a bearing on, the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-18 and 33-36 are currently pending in the application for consideration. Claims 19-32 have been cancelled. A copy of the claims involved in this appeal appears in the Claims Appendix of this Brief.

Claims 1-18 and 33-36 stand rejected. The rejections of claims 1-18 and 33-36 are being appealed.

IV. **STATUS OF AMENDMENTS**

No amendments have been filed after the final rejection.

V. **SUMMARY OF CLAIMED SUBJECT MATTER**

The following summary correlates claim elements to specific embodiments described in the application specification, but does not in any manner limit claim interpretation. Rather, the following summary is provided only to facilitate the Board's understanding of the subject matter of this appeal.

Claim 1 is directed to a mass produced absorbent article 10 comprising an absorbent member adapted to retain liquid therein, at least one other component operatively connected to the absorbent member in a unit and an image 11 including at least one ink having the color of one of cyan, magenta, yellow and black, and at least one other ink having a different color of one of cyan, magenta, yellow and black. See paragraphs [0024], [0026], and [0037] and Figure 1. The image 11 is printed in a non-contact manner on at least a portion of the at least one other component by ink jets at a resolution of about 100 dpi with the at least one other component moving under the ink jets at a speed of at least about 30.5 mpm (100 fpm). See paragraphs [0045] and [0050]. Wherein any area in the image 11 having a cyan colored ink applied at maximum threshold thereto has a coverage area ratio of cyan colored ink of at least about 3%, any area in the image 11 having a magenta colored ink applied at maximum threshold thereto has a coverage area ratio of magenta colored ink of at least about 5%, any area in the image 11 having a yellow colored ink applied at maximum

threshold thereto has a coverage area ratio of yellowed colored ink of at least about 6%, and any area in the image 11 having a black colored ink applied at maximum threshold thereto has a coverage area ratio of black colored ink of at least about 6%. See paragraphs [0057] and [0058]; Tables 1 and 2. Wherein each respective coverage area ratio is the percentage of any area in the image 11 which is covered by the corresponding cyan, yellow, magenta or black colored ink applied thereto. See paragraphs [0049] and [0051] and Figure 4.

Claim 33 is directed to a mass produced absorbent article 10 comprising an absorbent member adapted to retain liquid therein, at least one other component operatively connected to the absorbent member in a unit, and an image 11 including at least one ink having the color of one of cyan, magenta, yellow and black, and at least one other ink having a different color of one of cyan, magenta, yellow and black. See paragraphs [0024], [0026], and [0037] and Figure 1. The image 11 is printed in a non-contact manner on at least a portion of the at least one other component by ink jets at a resolution of about 100 dpi with the outer cover moving under the ink jets at a speed of at least about 30.5 mpm (100 fpm). See paragraphs [0045] and [0050]. Wherein a color difference (DE*) value for any cyan colored ink in the image as compared to a background color of the at least one other component on which the image is printed is at least about 6, the DE* value for any magenta colored ink in the image has a color difference (DE*) of at least about 9, the DE* value for any yellow colored ink in the image has a color difference (DE*) of at least about 8, and the DE* value for any black colored ink in the image has a color difference (DE*) of at least about 6. See paragraph [0052] and Table 1. Wherein each respective color difference (DE*) is the difference for the corresponding cyan, yellow, magenta or black

colored ink from a reference sample. See paragraphs [0049] and [0051] and Figure 4.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Appellants appeal the rejections of claims 1-13, 15-18, and 33-36 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,503,076 (Yeo) and U.S. Patent No. 6,680,784 (Nomura et al.).

B. Appellants appeal the rejection of claim 14 under 35 U.S.C. §103(a) as being unpatentable over Yeo in view of Nomura et al. and further in view of U.S. Patent No. 5,612,118 (Schleinz et al.)

VII. ARGUMENT

A. Claims 1-13, 15-18, and 33-36 are submitted to be nonobvious in view of and patentable over Yeo in view of Nomura et al.

Claims 1-13, 15-18, and 34-36

Claims 1, 4-10, 13, and 15-18

Claim 1 is directed to a mass produced absorbent article. The absorbent article comprises an absorbent member adapted to retain liquid therein, at least one other component operatively connected to the absorbent member in a unit, and an image. The image includes at least one ink having the color of one of cyan, magenta, yellow and black, and at least one other ink having a different color of one of cyan, magenta, yellow and black. The image is printed in a non-contact manner on at least a portion of the at least one other component by ink jets at a resolution of about 100 dpi with the at least one other component moving under the ink jets at a speed of at least about 30.5 mpm (100 fpm). Any area in the image having a cyan

colored ink applied at maximum threshold thereto has a coverage area ratio of cyan colored ink of at least about 3%, any area in the image having a magenta colored ink applied at maximum threshold thereto has a coverage area ratio of magenta colored ink of at least about 5%, any area in the image having a yellow colored ink applied at maximum threshold thereto has a coverage area ratio of yellowed colored ink of at least about 6%, and any area in the image having a black colored ink applied at maximum threshold thereto has a coverage area ratio of black colored ink of at least about 6%.

As mentioned in the specification, the recited article has an image that is darker (i.e., has more vibrant color) when the image is applied at high line speeds (e.g., 100 fpm or greater) even though the output of the print heads is set to dispense an unconventionally low quantity of ink (100 dots per inch). In other words, the image on the recited article is more vibrant, brighter, and stands out better visually than those of the prior art even though it is formed at a high line speed and with less ink. See page 22, paragraph [0050] of applicants' specification. At least to the inventors, this was counterintuitive and a surprising result. The intuitive solution to increasing the line speed is to increase the ink output to keep up with the faster moving article.

In particular, as discussed at column 7, paragraph [0053] of the present application, the recited coverage area ratios represent a greater coverage area ratio than is typically achieved for a resolution of 100 dpi. The greater coverage area is achieved as a result of the higher line speed at which the printed component is moving.

Claim 1 is submitted to be nonobvious in view of and patentable over Yeo in view of Nomura et al., in that whether considered alone or in combination the references fail to show

or suggest an absorbent article comprising an image including at least one ink having the color of one of cyan, magenta, yellow and black, and at least one other ink having a different color of one of cyan, magenta, yellow and black printed in a non-contact manner on at least a portion of the at least one other component by ink jets at a resolution of about 100 dpi with the at least one other component moving under the ink jets at a speed of at least about 100 fpm, and having the claimed coverage area ratios.

Yeo (with particular reference to Figs. 1 and 2 thereof), discloses a multi-color printed nonwoven web laminate 10 having a fibrous nonwoven facing layer 12, a substrate layer 14 and a plurality of adhesive-inks 16. The adhesive inks 16 adhesively bond the facing layer 12 to the substrate layer 14, and impart a multi-color pattern which is visible through the nonwoven facing layer 12. Yeo further discloses that flexographic and ink-jet printing can be used to apply the adhesive inks 16.

As noted in the final Office action at page 3, Yeo does not expressly disclose the coverage area ratios recited in claim 1. Rather, the Office takes the position that the ink concentrations described by Yeo are analogous to the coverage area ratios recited in present claim 1. Specifically, the Office asserts that "Yeo does allow for the pigment to be used in the claimed range as set forth in col. 2, lines 59-60." See, page 3 of the final Office action.

The portion of Yeo cited by the Office refers only to the composition of the colored adhesive inks used in Yeo. The passage, column 2, lines 59-60, recites in part that the ink comprises on a dry weight basis about 50 to about 99.5 percent of a polymer and about 0.5 to about 50 percent of a pigment.

Claim 1 recites various coverage area ratios that are a function of the total area within a graphic that contains the

respective color (cyan, magenta, yellow and black). The coverage area ratios **do not refer to the concentrations of the ink components.** Specifically, claim 1 recites, in part, that

> ***any area in the image*** having a cyan colored ink applied at maximum threshold thereto has a coverage area ratio of cyan colored ink of at least about 3%, ***any area in the image*** having a magenta colored ink applied at maximum threshold thereto has a coverage area ratio of magenta colored ink of at least about 5%, ***any area in the image*** having a yellow colored ink applied at maximum threshold thereto has a coverage area ratio of yellow colored ink of at least about 6%, and ***any area in the image*** having a black colored ink applied at maximum threshold thereto has a coverage area ratio of black colored ink of at least about 6%. Emphasis added.

The teaching by Yeo of ink composition concentrations thus fails to teach or even remotely suggest the claimed coverage area ratios. Rather, the coverage area ratio is based on the dpi used to print a particular color, the speed at which the printed component is printed, and the total area of that portion of the image over which the color is printed. It is not a direct function of the concentrations of the different components of the ink.

Nomura et al. do not add to the teachings of Yeo. Rather, Nomura et al. disclose a printer 1 having a paper feeder 3 for supplying paper to the inside of the printer, a print engine 20 for printing, and a paper discharge feeder 4 for discharging paper to the outside of the printer. The printer 1 is a dot matrix printer with a nine-pin head configuration and having a print density of 90 dpi. During use, upon reception of data for printing in a density other than 90 dpi, the received data

is converted to 90 dpi before printing by the printer 1. See, col. 2, lines 45-51. Error correcting means are also provided to correct errors that occur during the conversion of data to 90 dpi. See, col. 2, lines 63-67.

Nomura et al., which was relied on solely for its teaching of printing at 90 dpi, also fail to teach or suggest the recited coverage area ratios. Since Yeo and Nomura et al. each fail to disclose or even suggest the claimed coverage area ratios, a combination of the references must also fail to disclose or suggest this feature. Thus, claim 1 is submitted to be nonobvious in view of and patentable over Yeo in view of Nomura et al.

Additionally, as noted in the final Office action, Yeo fails to teach that the adhesive ink can be applied at a resolution of about 100 dots per inch (dpi) as recited in claim 1. See page 3 of the final Office action. In fact, Yeo is completely silent regarding the number of dpi used to apply the adhesive ink to the article. Even more so, Yeo is silent as to any relationship between the resolution and the line speed of the component onto which the image is printed. Nomura et al. is completely silent as to a line speed at which the paper is moved past the print head of the printer. That is, one skilled in the art cannot glean from Nomura et al. that a 100 dpi resolution is achievable or beneficial for paper moving at the line speed recited in claim 1.

It is the combination of low resolution (i.e., 100 dpi) and high line speed (i.e., 100 fpm) at which the printing is occurring that renders the claimed invention patentable over the prior art including Yeo and Nomura et al. In other words, there is no reason evident in Yeo or Nomura et al. from which one skilled in the art would find it obvious to print images at a low resolution (e.g., 100 dpi) onto a component moving a high

line speed (i.e., 100 fpm), or otherwise predictable that such a feature would result in the recited vibrant image. Furthermore, there is simply no suggestion in either Yeo or Nomura et al. for printing images at a low resolution (e.g., 100 dpi) onto a component having a high line speed (i.e., 100 fpm).

As set forth in the Declaration filed January 15, 2007 (a copy of which is included herein in the Evidence Appendix), absorbent articles such as diapers and training pants are typically manufactured in a line process in which the various components of the article are assembled together at high speeds such as 100 feet per minute (as mentioned in Yeo) and more often about 1,200 feet per minute or more. Prior to the present invention, due in part to print head limitations, graphic images that appear on such articles were applied by ink jet printing in an off-line process in which the graphic was imprinted on a film or non-woven web off-line, at lower speeds and over multiple passes of the web past the print head. The printed web was subsequently introduced to the manufacturing line at the higher line speed. The resolution of such images was about 300 dpi to about 600 dpi or even higher.

The quality of an image produced by a drop on demand ink jet printer has long been thought to be a function of the resolution of the image, i.e., a certain area of coverage of the substrate by the ink. The image resolution is typically defined in terms of the surface area of the web covered by a given amount of ink, and more particularly the ink dot density which is commonly given as dots-per-inch (dpi). A greater dpi has thus been associated with a greater resolution, and hence an increased quality ink jet image on the web. For example, the reference text submitted with the Declaration notes that conventional printing is typically performed at a resolution of

254-770 dpi, and for textile printing the resolution should be about 720 dpi.

The problem to be addressed by the inventors was to print at higher speeds than were available in off-line printing processes, while maintaining or increasing the resolution of the image printed on the web. Achieving this would allow the web to be printed on the main assembly line, i.e., at line speed, thereby reducing the number of processing steps, increased flexibility in changing graphics during manufacturing, and providing other manufacturing efficiencies and cost savings. The teachings known to those skilled in the art at the time of the invention dictated that to maintain the image quality of the graphic at the desired higher line speeds, the resolution of the graphic image on the web would have to at least stay the same (e.g., 300 to 600 dpi), meaning that the print head would have to output more ink as the line speed increased. Neither Yeo nor Nomura et al. teach or suggest otherwise.

U.S. Patent No. 6,957,884, which is incorporated by reference into the present specification at paragraph [0043], page 17 as U.S. Patent Application No. 10/330,515, also discusses the shortcomings of ink jet printers. For example, the '844 patent states that "there has been much progress in the area of piezo jet printing however, heretofore, the piezo jet printers were limited in that they were not able to handle high-speed process printing" (col. 1, lines 38-41), and "piezo jet printing apparatus currently available lack the ability to create multi-color process images at high speeds" (col. 1, line 66 through col. 2, line 1). Applicants point out that the date of the '884 patent is closer to the date of the present invention than Nomura et al. and is submitted to be more

indicative of the conventional wisdom in the art at the time of this invention than Nomura et al.

During experiments conducted by the inventors, however, the graphic produced at higher dpi (using faster print-head output and more ink) and higher line speed rates was blurred, or smeared. Also during these experiments, the inventors increased the line speed (at which the printing occurred) even further, thus exceeding the ink delivery rate capabilities of the print head to see just how high of a line speed the print head could be used with. Exceeding the capabilities of the print head certainly is not a solution that would have been obvious to one skilled in the art. Indeed, this resulted in the image resolution dropping substantially below 300 dpi. Unexpectedly and unpredictably, the quality of the image was as good as, or better than, images previously produced at 300-600 dpi and slower line speeds and certainly better than images produced at 300-600 dpi at the higher line speeds.

As a result of their experimentation, the inventors determined that high quality images could be produced on absorbent articles moving at line speeds of 30.5 meters per minute (100 feet per minute) or greater using ink jet printing with a resolution of about 100 dots per inch (dpi). Such a result was unpredictable and unexpected in view of the previously common belief that increasing line speeds required a more rapid ink delivery rate (relative to the line speed) to the web, not a lower rate.

The position taken by the Office in this final Office action is that it would have been obvious to modify Yeo in view of the teachings of Nomura et al. to have the recited image of Yeo printed at 100 dpi because the recited resolution according to Nomura et al. can be used to produce an excellent quality image. However, Nomura et al. fail to disclose the rate at

which the paper moves (e.g., the line speed of the paper) past the print head and further fail to disclose or suggest any relationship between the image resolution and the line speed. Based on the commonly understood relationship between resolution, line speed and image quality in a conventional dot matrix printer at the time of applicants' invention, one would expect that the paper movement speed in Nomura et al. would have to be relatively low (i.e., substantially slower than 100 fpm).

The Office's position thus goes against the commonly understood relationship between resolution, line speed, and image quality at the time of the applicant's invention. As discussed previously herein and in the previously submitted declaration, the recited image having a resolution of 100 dpi unexpectedly provides the desired image quality that was heretofore achieved only at higher resolutions and lower line speeds. Indeed, Nomura et al. specifically disclose that as the print speed increases, the quality of the printed image decreases. See, col. 1, lines 13-19. Accordingly, the recited reduced resolution, at higher line speeds, is counterintuitive and contrary to the teachings of the prior art and the knowledge of those skilled in the art at the time of the present invention.

For all of the above reasons, claim 1 is submitted to be non-obvious in view of and patentable over the references of record including Yeo in combination with Nomura et al.

Claims 4-10, 13, and 15-18 depend either directly or indirectly from claim 1 and are submitted to be patentable over the references of record for at least the same reasons as claim 1.

Claims 2 and 3

Claims 2 and 3 each depend directly from claim 1 and further recite higher coverage area ratios for cyan, magenta, yellow and black, respectively. As disclosed at Table 2 of the present application, when the printing resolution is 100 dpi, the coverage area ratio of the printed image is achieved only at higher line speeds. However, as discussed above in connection with claim 1, operating at such high line speeds while printing at a low resolution (e.g., 100 dpi) is against conventional wisdom prior the present invention.

Accordingly, for at least the same reasons set forth above in connection with claim 1, claims 2 and 3 are further submitted to be patentable over the references of record.

Claims 11 and 12

Claim 11, which depends indirectly from claim 1, further recites that the image includes multiple separable design elements, none of the design elements being smaller than about 0.64 centimeters (0.25 inches) in height. Claim 12 depends from claim 11 and further recites that one of the design elements constitutes a focal design element, the height of the focal design element being at least about 1.91 centimeters (0.75 inches).

Neither Yeo nor Nomura et al. disclose the dimension of a design element, nor would it would have been obvious to one of ordinary skill in the art to modify Yeo or Nomura et al. on the basis that discovering the optimum value of a result effective variable involves only routine skill in the art. See page 4 of the final Office action citing *In re Boesch and Slaney*.

Such a position appears to be the very position rejected by the court in *In re Antonie* 195 USPQ 6 (CCPA 1977). In particular, the court noted that an assertion that it would

always be obvious to one of ordinary skill in the art to try varying every parameter of a system in order to optimize the effectiveness of the system is improper "if there is no evidence in the record that the prior art recognized that particular parameter affected the result." *Id*. at 8 (emphasis added). Thus, the court made it clear that the recognition of a particular parameter as a result-effective variable must come from the cited reference.

In this case, neither Yeo nor Nomura et al. teach that the dimension of the design element is a result-effective variable.

For these additional reasons, claims 11 and 12 are further submitted to be non-obvious and patentable over the references of record.

Claim 34

Claim 34 depends from claim 1 and further recites that the image contains ink applied to said at least one component by the ink jet with dots having a uniform volume of ink.

Yeo lacks any teaching or suggestion whatsoever regarding the volume or sizes of the dots used during ink jet printing. Instead, the portions of Yeo cited by the Office in rejecting claim 34, col. 4, lines 8-22 and col. 8, line 66 to col. 9, line 10, are only directed to a general description of ink jet printing.

As a result, claim 34 is submitted to be further non-obvious in view of and patentable over Yeo in combination with Nomura et al.

Claim 35

Claim 35 depends from claim 1 and further recites that the image comprises ink dots of generally uniform size. As mentioned with respect to claim 34, Yeo lacks any teaching or

suggestion whatsoever regarding the sizes of the dots used during ink jet printing. Instead, the portions of Yeo cited by the Office in rejecting claim 35, col. 4, lines 8-22 and col. 8, line 66 to col. 9, line 10, are only directed to a general description of ink jet printing.

As a result, claim 35 is submitted to be further non-obvious in view of and patentable over Yeo in combination with Nomura et al.

Claim 36

Claim 36 depends from claim 1 and recites that the at least one other component comprises a non-woven material, the image being disposed on the non-woven material.

Those skilled in the art of printing will readily appreciate that printing on non-woven material is more difficult than printing on standard paper because of the substantial higher void space of the non-woven material. During the printing process, a significant amount of ink is captured by the voids in the non-woven material which inhibits the ink from spreading laterally outward. Again, the conventional wisdom in the art of printing, prior to this invention, would be to add more ink to compensate for the ink being captured by the voids.

While Yeo discloses printing on non-woven material, one of ordinary skill in the art would not be motivated by Nomura et al. to print on a non-woven material at 100 dpi because doing so goes against the conventional wisdom in the art. Nomura et al. is directed specifically to printing on paper which is much denser and has much less void space. As a result, it is easier to print on paper than a non-woven material because ink is not captured by the voids. Instead, the ink is held near the surface of the paper where it is clearly visible. Thus, it

takes less ink to print on paper than on non-woven material to achieve the same, or nearly the same, quality image. Accordingly, one of ordinary skill in the art at the time of this invention would not have been motivated to print on a non-woven as taught by Yeo at a high line speed and 100 dpi as disclosed by Nomura et al. because the skilled artist would have believed a significantly greater dpi would be necessary to achieve a quality image.

For these additional reasons, claim 36 is submitted to be further non-obvious in view of and patentable over Yeo in combination with Nomura et al.

Claim 33

Claim 33 is directed to a mass produced absorbent article comprising an absorbent member adapted to retain liquid therein, at least one other component operatively connected to the absorbent member in a unit, and an image including at least one ink having the color of one of cyan, magenta, yellow and black, and at least one other ink having a different color of one of cyan, magenta, yellow and black, the image being printed in a non-contact manner on at least a portion of said at least one other component by ink jets at a resolution of about 100 dpi with the outer cover moving under the ink jets at a speed of at least about 30.5 mpm (100 fpm), wherein a color difference (DE*) value for any cyan colored ink in the image as compared to a background color of said at least one other component on which the image is printed is at least about 6, the DE* value for any magenta colored ink in the image has a color difference (DE*) of at least about 9, the DE* value for any yellow colored ink in the image has a color difference (DE*) of at least about 8, and the DE* value for any black

colored ink in the image has a color difference (DE*) of at least about 6.

Claim 33 is submitted to be non-obvious in view of and patentable over Yeo in view of Nomura et al. for reasons similar to those discussed above in connection with claim 1. That is, whether considered alone or in combination the references fail to teach or suggest the recited absorbent article wherein the image including at least one ink having the color of one of cyan, magenta, yellow and black, and at least one other ink having a different color of one of cyan, magenta, yellow and black printed in a non-contact manner on at least a portion of the at least one other component by ink jets at a resolution of about 100 dpi with the outer cover moving under the ink jets at a speed of at least about 30.5 mpm (100 fpm). The references also fail to teach or suggest the claimed color difference (DE*) values.

As noted in paragraphs [0049-0052] and Table 2 of the present application, the color difference values are generally a function of the dot resolution and the speed at which the printed component is moved past the printer. The color differences claimed in claim 33 are achieved at a 100 dpi resolution by using a faster line speed than conventional wisdom would suggest as discussed above. Thus, one skilled in the art would not have found it obvious to provide the recited color difference values at such a low resolution (100 dpi).

For the above reasons, claim 33 is submitted to be non-obvious in view of and patentable over the references of record.

B. Claim 14 is submitted to be nonobvious in view of and patentable over Yeo in view of Nomura et al. and further in view of Schleinz et al.

Claims 14

Claim 14 depends from claim 1 and recites that the single-layer absorbent structure has a subtended angle of about 180 degrees or less in the presence of a liquid. Claim 7 is submitted to be nonobvious in view of patentable over Yeo in view of Nomura et al. and further in view of Schleinz et al. for at least the same reasons as claim 1 based on its dependency therefrom.

CONCLUSION

For the reasons stated above, Appellants respectfully request that the Office's rejections be reversed and that claims 1-18 and 33-36 be allowed.

Respectfully submitted,

/Richard L. Bridge/

Richard L. Bridge, Reg. No. 40,529
ARMSTRONG TEASDALE LLP
One Metropolitan Square, 26th Floor
St. Louis, Missouri 63102
(314) 621-5070

RLB/PEB/AGH
Via EFS

VIII. CLAIMS APPENDIX

1. A mass produced absorbent article comprising an absorbent member adapted to retain liquid therein, at least one other component operatively connected to the absorbent member in a unit, and an image including at least one ink having the color of one of cyan, magenta, yellow and black, and at least one other ink having a different color of one of cyan, magenta, yellow and black, the image being printed in a non-contact manner on at least a portion of said at least one other component by ink jets at a resolution of about 100 dpi with said at least one other component moving under the ink jets at a speed of at least about 30.5 mpm (100 fpm), wherein any area in the image having a cyan colored ink applied at maximum threshold thereto has a coverage area ratio of cyan colored ink of at least about 3%, any area in the image having a magenta colored ink applied at maximum threshold thereto has a coverage area ratio of magenta colored ink of at least about 5%, any area in the image having a yellow colored ink applied at maximum threshold thereto has a coverage area ratio of yellowed colored ink of at least about 6%, and any area in the image having a black colored ink applied at maximum threshold thereto has a coverage area ratio of black colored ink of at least about 6%, and wherein each respective coverage area ratio is the percentage of any area in the image which is covered by the

corresponding cyan, yellow, magenta or black colored ink applied thereto.

2. An absorbent article as set forth in claim 1 wherein any area in the image having a cyan colored ink applied at maximum threshold thereto has a coverage area ratio of cyan colored ink of at least about 4%, any area in the image having a magenta colored ink applied at maximum threshold thereto has a coverage area ratio of magenta colored ink of at least about 7%, any area in the image having a yellow colored ink applied at maximum threshold thereto has a coverage area ratio of yellowed colored ink of at least about 9%, and any area in the image having a black colored ink applied at maximum threshold thereto has a coverage area ratio of black colored ink of at least about 7%.

3. An absorbent article as set forth in claim 1 wherein any area in the image having cyan colored ink applied at maximum threshold thereto has a coverage area ratio of cyan colored ink of at least about 5%, any area in the image having a magenta colored ink applied at maximum threshold thereto has a coverage area ratio of magenta colored ink of at least about 8%, and any area in the image having a black colored ink

applied at maximum threshold thereto has a coverage area ratio of black colored ink of at least about 8%.

4. An absorbent article as set forth in claim 1 further comprising a background on which the image is printed.

5. An absorbent article as set forth in claim 4 where in the background is white.

6. An absorbent article as set forth in claim 5 wherein said component comprises an outer cover, the background being defined by the color of the outer cover.

7. An absorbent article as set forth in claim 6 wherein the white background comprises a layer of white ink applied to at least a portion of the outer cover.

8. An absorbent article as set forth in claim 1 wherein the image includes at least one separable design element having a periphery and an interior, the interior being free of shading of black ink.

9. An absorbent article as set forth in claim 8 wherein said at least one design element is outlined in black ink.

10. An absorbent article as set forth in claim 9 wherein the black ink is applied at the highest threshold for a selected resolution.

11. An absorbent article as set forth in claim 8 wherein the image includes multiple separable design elements, none of the design elements being smaller than about 0.64 centimeters (0.25 inches) in height.

12. An absorbent article as set forth in claim 11 wherein one of the design elements constitutes a focal design element, the height of the focal design element being at least about 1.91 centimeters (0.75 inches).

13. An absorbent article as set forth in claim 1 wherein the inks are wax-based.

14. An absorbent article as set forth in claim 1 wherein the outer cover is made of an extensible material.

15. An absorbent article as set forth in claim 1 wherein the absorbent article is one of: a diaper, a training pant and an adult incontinence garment.

16. An absorbent article as set forth in claim 1 wherein a color difference (DE*) value for any cyan colored ink in the image as compared to a background color of said component on which the image is printed is at least about 6, the DE* value for any magenta colored ink in the image has a color difference (DE*) of at least about 9, the DE* value for any yellow colored ink in the image has a color difference (DE*) of at least about 8, and the DE* value of any black colored ink in the image has a color difference (DE*) of at least about 6.

17. An absorbent article as set forth in claim 1 further comprising an overlay covering the image.

18. An absorbent article as set forth in claim 17 wherein the overlay comprises a clear, non-pigmented ink applied over the top of the image.

33. A mass produced absorbent article comprising an absorbent member adapted to retain liquid therein, at least one other component operatively connected to the absorbent member in a unit, and an image including at least one ink having the color of one of cyan, magenta, yellow and black, and at least one other ink having a different color of one of cyan, magenta,

yellow and black, the image being printed in a non-contact manner on at least a portion of said at least one other component by ink jets at a resolution of about 100 dpi with the outer cover moving under the ink jets at a speed of at least about 30.5 mpm (100 fpm), wherein a color difference (DE*) value for any cyan colored ink in the image as compared to a background color of said at least one other component on which the image is printed is at least about 6, the DE* value for any magenta colored ink in the image has a color difference (DE*) of at least about 9, the DE* value for any yellow colored ink in the image has a color difference (DE*) of at least about 8, and the DE* value for any black colored ink in the image has a color difference (DE*) of at least about 6, and wherein each respective color difference (DE*) is the difference for the corresponding cyan, yellow, magenta or black colored ink from a reference sample.

34. An absorbent article as set forth in claim 1 wherein the image contains ink applied to said at least one component by the ink jet with dots having a uniform volume of ink.

35. An absorbent article as set forth in claim 1 wherein the image comprises ink dots of generally uniform size.

36. An absorbent article as set forth in claim 1 wherein said at least one other component comprises a non-woven material, the image being disposed on the non-woven material.

IX. EVIDENCE APPENDIX

The following declaration was entered into the record on January 15, 2007.

KCC 4985
K-C 19,691
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of Anderson et al. Art Unit 3761
Serial No. 10/623,030
Filed July 18, 2003
Confirmation No. 4469
For ABSORBENT ARTICLE WITH HIGH QUALITY INK JET IMAGE PRODUCED AT LINE SPEED
Examiner Laura C. Hill

January 10, 2007

DECLARATION OF KIMBERLY D. ANDERSON, MICHAEL J. GARVEY, MELISSA C. PUTZER, TIMOTHY PROBST, AND ERIC D. JOHNSON

TO THE COMMISSIONER FOR PATENTS,

SIR:

We, Kimberly D. Anderson, Michael J. Garvey, Mel~~l~~issa C. Putzer, Timothy Probst, and Eric D. Johnson, declare as follows:

1. We are the co-inventors of the subject matter claimed in U.S. Patent Application No. 10/623,030, filed on July 18, 2003.

2. Drop on demand piezoelectric ink jet printing apparatus (e.g., ink jet non-contact printing systems) have been used to apply inks to a variety of substrates. Generally, a drop on demand piezoelectric ink jet printing apparatus discharges small individual droplets of ink onto a substrate in a predetermined pattern. In this type of printing apparatus, the print head does not contact the substrate on which the image is printed. Such apparatus typically incorporate a print head having an array of orifices in a block, and a controller. Each orifice is

designed to emit a single droplet of ink onto the substrate each time its associated print head fires.

3. The quality of an image produced by a drop on demand ink jet printer has long been thought to be a function of the resolution of the image, i.e., a certain area of coverage of the substrate by the ink. See Digital Printing of Textiles, Woodhead Publishing, 2006, section 7.4.1 (a copy of which is attached hereto. The image resolution is typically defined in terms of the surface area of the web covered by a given amount of ink, and more particularly the ink dot density which is commonly given as dots-per-inch (dpi). A greater dpi has thus been associated with a greater resolution, and hence an increased quality ink jet image on the web.

4. Absorbent articles such as diapers and training pants are typically manufactured in a line process in which the various components of the article are assembled at high speeds such as 100 feet per minute and more often about 1,200 feet per minute or more. Prior to the present invention, due in part to print head limitations, graphic images that appear on such articles were applied by ink jet printing in an off-line process in which the graphic was imprinted on a film or non-woven web off-line, at lower speeds and over multiple passes of the web past the print head, and the graphic web was subsequently introduced to the manufacturing line at the higher line speed. The resolution of such images was about 300 dpi to about 600 dpi or even higher.

5. We deemed it advantageous, however, to be able to print graphics onto the moving article in a single pass and at the higher line speeds (e.g., the manufacturing line speed), such as a reduced number of processing steps, increased flexibility in changing graphics during manufacturing and other manufacturing efficiencies.

6. About the time of our invention of the presently claimed subject matter, we experimented with new print head technology operating at higher line speeds. Conventional wisdom dictated that to maintain the image quality of the graphic, the resolution of the graphic image would have to at least stay the same (e.g., 300 to 600 dpi) at higher line speeds, meaning that the print head would have to output more ink as the line speed increased.

7. Accordingly, as the line speed was increased during the experiment, we increased the ink delivery rate to maintain the dpi of the graphic. However, unexpectedly, the graphic produced at these dpi and higher line speed rates was blurred, or smeared.

8. Upon further increasing the line speed, we exceeded the ink delivery rate capabilities of the print head so that the dpi of 300-600 could no longer be maintained (e.g., to see just how high of a line speed the print head could be used with). This resulted in the image resolution dropping substantially below 300 dpi. However, the quality of the image was unexpectedly as good as, or better than, images previously produced at 300-600 dpi and slower line speeds

and certainly better than images produced at 300-600 dpi at the higher line speeds.

9. As a result of our experimentation, we determined that high quality images could be produced on absorbent articles moving at line speeds of 30.5 meters per minute (100 feet per minute) or greater using ink jet printing with a resolution of about 100 dots per inch (dpi). Such a result was unexpected in view of the previously common belief that increasing line speeds required a more rapid ink delivery rate (relative to the line speed) to the web, not a lower rate.

10. U.S. Patent No. 6,096,412 (McFarland et al.), which is cited in the final Office action dated August 15, 2006, specifically teaches that "[t]he higher color density of the ink, the greater the intensity or strength of the color." See col. 19, lines 3-5. This reflects the conventional thinking of those skilled in the art prior to the present invention that the more ink that is applied to the article the greater the quality of the image. The present invention, however, allows less ink to be used while obtaining high quality graphics at higher line speeds. Thus, producing an article with a more vibrant, brighter image while using less ink is indeed an unexpected result in view of the teachings of McFarland et al.

11. Each of us declare that all statements made herein are true; and further that these statements were made with the knowledge that willfully making false statements is punishable by fine, imprisonment, or both, under 18 U.S.C.

§1001 and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

January 10, 2007 Date	Kimberly D. Anderson Kimberly D. Anderson
January 10, 2007 Date	Michael J. Garvey
January 12, 2007 Date	Melissa C. Putzer MCP Mel~~l~~issa C. Putzer
January 12, 2007 Date	T Pb Timothy Probst
January 11, 2007 Date	Eric D. Johnson Eric D. Johnson

7.3 Market needs for digital textile printing

There are various market needs for digital textile printing that differ from WFPs for graphics, compared to conventional screen textile printing:

- Productivity: 20–30 m^2/h print speed for practical use
- High resolution: enabling printing of fine tie patterns
- Support of various fabric types: stretching/shrinking, thin, raising fabric, etc.
- Color reproduction: equal or higher color gamut to screen textile printing; high color reproduction when reprinting or between different models
- Strike-through: color permeability to rear surface (especially for scarves)
- High fastness: equal fastness to screen textile printing
- Low running costs: slightly higher printing costs than manual textile printing.

The importance and achievement level of these needs differ depending on the intended purpose of the digital textile printing. For small lot production, productivity and running costs are especially important because of printing end products. For color correction printing, color reproduction and high resolution are important. Before now, many users who introduced the Tx series had used several printers for small lot production. Therefore, the highest market need is demand for productivity and running costs.

7.4 Technical issues and solutions

7.4.1 High resolution images

The quality of digitally printed images is determined by printer resolution, variable dot size, and fabric feed accuracy of digital textile printers, and those factors are now discussed.

Resolution

Printers with finer resolution produce higher-quality output. Conventional screen printers typically use 100 to 300 mesh screens, resolution of which is comparable to 254–770 dpi (100 μm down to 33 μm) for the resolution of digital images. For textile printers, 720 dpi is a practical and necessary plotting resolution. To print actual images with resolution equivalent to that of paper ink-jet printers, it is important to inject the proper amount of ink that gives the right dot length on the textile appropriate to the resolution from the nozzle.

The Tx series adopts a 720 dpi plotting resolution. Realizing 80–100 μm print dot length by 5–25 pl (1 pl = 10^{-12} liter) ink drop size, high-resolution printing is available. The nozzle hole pitch of the ink-jet head incorporated in the Tx series is 180 dpi (141 μm). However, it is capable of performing real 720-dpi resolution (35 μm) printing by scanning four times separately between nozzles. Also, for enhancing image quality, it is possible to print a scanning dot line

every dot using two types of nozzle. In this case, 720 × 720 dpi meshes will be coated by scanning eight times. In the same way, a printing mode using 16 times scanning is available. Printing using multiple scanning is time-consuming. So it is necessary to use the appropriate mode depending on the desired print quality.

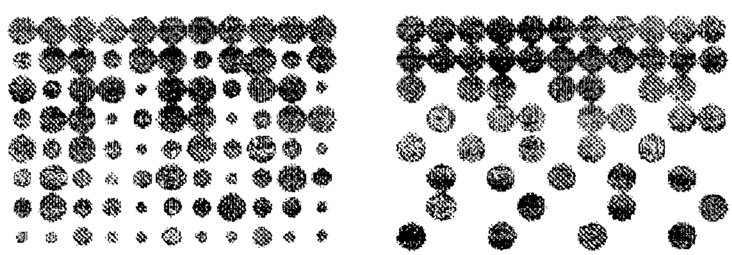
Variable dot size

Popular methods for color tone control are digital dithering, pseudo halftone reproduction using an error diffusion method, and combination with light colors. In gradation of dark colors only, graininess is often apparent in the highlight area where basic dots are large and dark. Use of smaller dots with those methods is effective in reducing graininess and preventing a tone-jump phenomenon. Tx2 and Tx3 printers are capable of manipulating dots in three sizes as shown in Fig. 7.6. These dots in different sizes allow smooth tone gradation with less graininess.

Fabric feed accuracy (banding prevention)

When feed fluctuations for every head scan occur, a striped pattern in the scanning direction (banding) is seen on the resulting print and leads to poor image quality. Banding occurs chiefly because of faulty fabric feed and irregularities in the fabrics themselves. Its causes are as follows:

- Existence or nonexistence of slippage at fabric clamping mechanism part (printer)
- Tension uniformity of fabric (printer)
- Stretch fabric or not (fabric, material)
- Fabric wet expansion/shrinkage by ink (fabric, material)
- Slippery surface of fabric (fabric, material)



(a) (b)

7.6 Tone gradation by variable-sized dots: (a) with variable dot sizes; (b) with a single dot size.

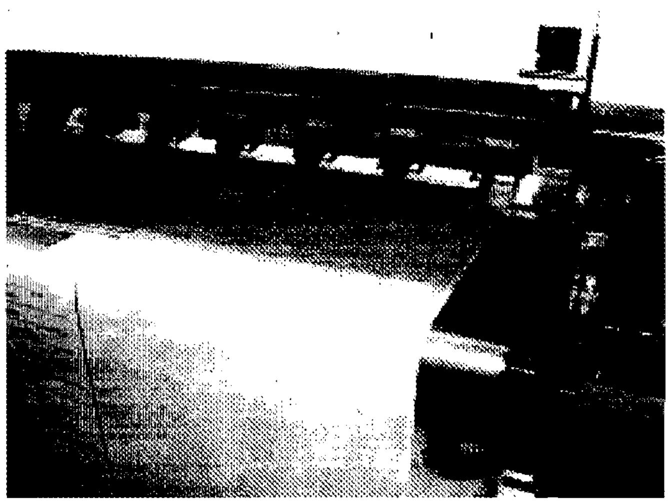
- Concavity and convexity of fabric (embossment, crape) (fabric, material)
- Uniformity of edge of roll fabric (in shape) (fabric, pre-treatment)
- Meandered or curved fabric (fan-like, deformation to s-shape) (fabric, pre-treatment).

The feeder must be equipped with a mechanism that prevents a fed fabric from slipping, and fabric can withdraw easily from it to prevent fabric from imperfection. As the anti-slip mechanism, the Tx2-1600 (Fig. 7.7) and Tx3-1600 (Fig. 7.8) have knurled rollers and a feed system using an adhesive belt (table adhesive method), respectively. The knurled rollers of Tx2 have fine projections on the stainless-steel surface and have strong friction in the thrust direction when winding fabric. If the height of toothing is too great, the amount of toothing to be pierced into the fabric will increase and lead to imperfection in the fabric. Also, fabric cannot be easily withdrawn.

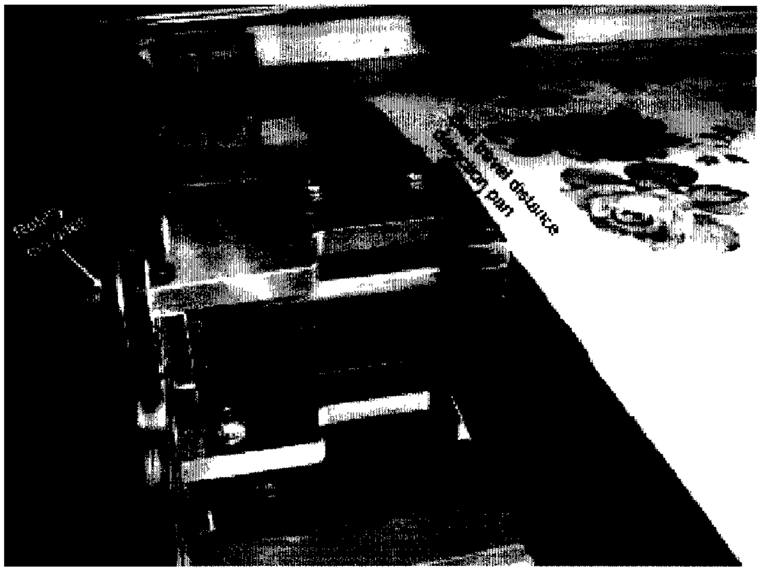
Feeding is performed under fixed tension, pulling the entire fabric by the roller with special surface treatment at the point immediately after printing (Fig. 7.9). Applying clingy paste to the wide endless belt surface, an adhesive belt feeds fabric by sticking it to the belt. Because the entire fabric sticks to the belt, stretch material such as knit can be fed and textiles are prevented from wet expansion/shrinkage by ink. As the adhesive power of paste will deteriorate with use, it is necessary to put paste on the belt periodically. Also, varying thickness

7.7 Tx2 feeding roller.

7.8 Tx3 feeding belt.



7.9 Tx2 fabric tension mechanism.

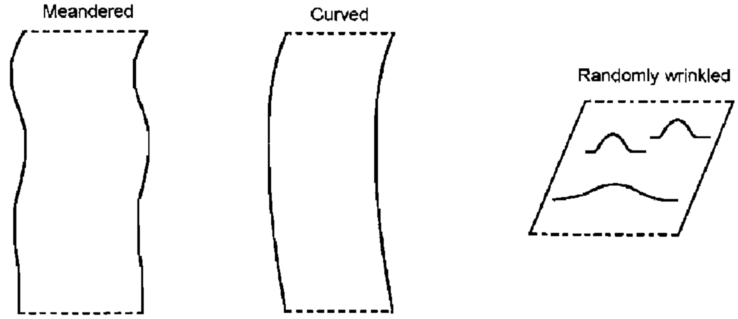


7.10 Tx3 detecting the travel distance of the belt.

of the feeding belt and non-uniform paste lead to accidental errors in fabric feed accuracy. In order to correct feed fluctuations, movement of the belt is controlled by detecting its travel distance at the final stage by a rotary encoder with a feedback system to the belt driver motor (Fig. 7.10).

To reduce variations of the tension applied to the fabric, the Tx2-1600 has a torque limiter and a conditioning roller mechanism followed by the drive section; the Tx3-1600 has parallel tensioning bars. Generally, when feed accuracy has $\pm 20\,\mu$m or more accidental error, visible banding tends to occur. As mentioned above, fabric characteristics such as expansion/shrinkage, wet expansion/shrinkage by ink, slippery surface, concavity and convexity also affect banding.

Pre-treatment of fabric consists of impregnation by an agent mainly consisting of paste and then drying. This pre-treatment can prevent bleeding of dye inks and improve feed performance. (Section 7.4.3 explains the details of prevention of bleeding.) For fabrics woven with a hard twist and large expansion/shrinkage, pre-treatment paste coating should be increased to improve feed performance. Adjustment of the composition of the agent, width of the tenter, speed and strength of take-up by the fabric all affect the result. If the make-up of the agent is not suitable, fabric may be starched or stressed, causing skewed feeding, meandering, and non-uniform pitch. These cause banding. Figure 7.11 shows typical examples of results of pre-treatment. Skewing of the fabric causes banding, fabric slip upon feeding, and wrinkles, eventually leading



7.11 Skewing caused in the pre-treatment.

to the head nozzle dragging on the print fabric surface and to fabric jamming in the printer.

7.4.2 Color reproduction

Figure 7.12 compares the color gamuts of reactive dyes, acid dyes, disperse dyes, and water-based pigment inks. The figure suggests that the color gamut of dye inks compares favorably with that of pigment ink.

7.4.3 Prevention of bleeding

Conventional screen printing and ink-jet printing use different pastes for print inks. To prevent ink bleed, screen printing uses a volume of pastes that makes inks much more viscous than those for ink-jet printing for dye. We call the mixture of textile dye ink and pastes 'printing pastes'. Hand screen printing, automatic flat-bed screen printing, and rotary screen printing use pastes with lower viscosity in that order. Generally, screen printing uses pastes with viscosity of some hundreds to tens of thousands of mPa·s. Ink-jet printing adopts pastes with much lower viscosity, from a few to over 10 mPa·s. It requires light pastes for spraying ink droplets of a few to several tens of picoliters in size at a high jet frequency of approximately 10 kHz from the printer head nozzles. Ink droplets with low viscosity pastes would produce ink bleed on a fabric. Therefore, coating the target fabric with a pre-treatment agent, the main element of which is a paste, is necessary.

Ink bleed and strike-through on the printed fabric occur due to a capillary phenomenon. The ink penetration length through the capillary is calculated with the Lucas–Washburn equation, which expresses the relation between the penetration length L and the viscosity δ as follows:

$$L \propto \delta^{-1/2} \tag{7.1}$$

X. **RELATED PROCEEDINGS APPENDIX**

None.